

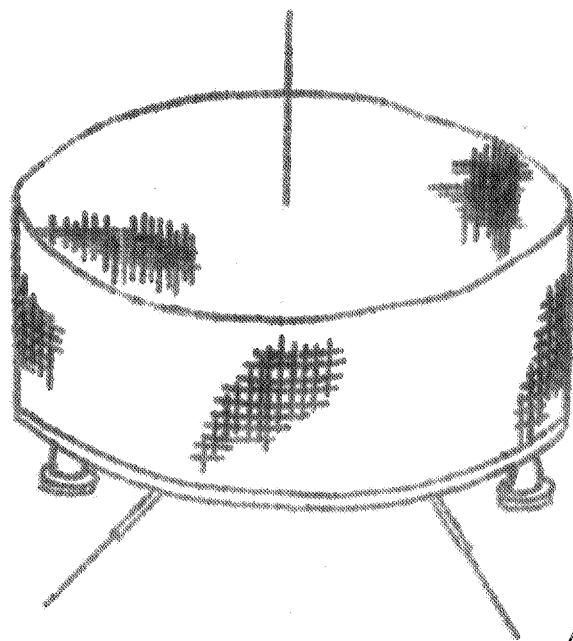
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GOORDARD SPACE FLIGHT CENTER

DELTA 7

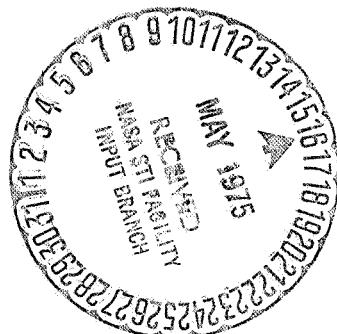
FLIGHT FLASH REPORT

T + 8 HOURS



TIROS

D  
4



8 FEBRUARY 1975

(NASA-TM-X-66811) DELTA 7 FLIGHT FLASH  
REPORT T PLUS 8 HOURS, TIROS D (NASA) 9 p

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GODDARD SPACE FLIGHT CENTER  
FIELD PROJECTS BRANCH

DELTA 7 FLIGHT FLASH REPORT

February 8, 1962

1.0 SUMMARY

Delta 7 (Tirce D), vehicle 317/2020/3020, was launched 8 February 1962 at 0743 EST. First and second stage performance was nominal or better. Third stage performance appears to be nominal as indicated by available data from the AMR Doppler Station and preliminary orbital predictions. The spacecraft was placed in orbit and is reported to be operating satisfactorily.

2.0 LAUNCH PREPARATIONS

2.1 F-6 Day Operation

The normal F-6 day tests were conducted on 29 January 1962. During analysis of the records, it was noted that the programmer time between sequence 3 and sequence 4 was off by 1/2 second. Subsequent testing indicated the programmer was susceptible to voltage spikes. The programmer was replaced with a spare and operated properly.

2.2 F-3 Day Operation

The F-3 day operations were conducted on 1 February 1962 with no difficulties being encountered.

2.3 F-1 Day Operation

F-1 day countdown began at 0730 EST, T-495 minutes on 5 February 1962. Engine checks were completed at 0915 with no problems. Payload checks were run from 0945 EST to 1036 EST. Electrical systems checks started at 0925 EST.

On the second stage programmer run on external power, ETL failed to send SECO. Apparently ETL did not have a deuce tape available for the external run. Another external run was made with ETL sending a manual SECO.

On the second stage slew checks, it was noted on telemetry that the second stage engine pitch position had a jump in level of about 2 percent near the full down position. Subsequent checks proved the engine was not jumping at the time of this abnormality and the indication was from an intermittent telemetry pot. This faulty indication occurred only near the full pitch down position. After much discussion, it was decided to fly with the pot in that condition since only telemetry was affected and the control system operation would not be jeopardized.

Second stage propellant servicing began at 1400 EST and was completed at 1529 EST. Retro bottle pressurizing started at 1600 EST and was completed at 1646 EST which completed the F-1 day count.

2.4 F-0 Day Operation (6 February 1962)

The normal F-0 day operations were conducted with no difficulties being encountered until the one hour built in hold. During the hold the vehicle nose

fairing was removed to conduct a special check of the spacecraft IM recorder. The tests revealed the recorder to be operating properly. Upon completion of one hour built-in hold the terminal count was initiated. During start tank pressurization sequence it was noted that the pressurization regulator was at an out of spec high value. A hold was called and an inspection crew went to the vehicle to correct the difficulty. Upon resetting and exercising the regulator it was determined to be operating properly.

Upon completion of the inspection and regulator setting, the work platform under the engine was inoperative and had to be moved into the retired position with a hand operated "come along" and the Pad area again cleared. At this time it was determined that insufficient time remained to permit launch during the permissible launch window. Therefore, the launch was scrubbed.

### 2.5 F-O Day Operation (7 February 1962)

The F-O day operation proceeded without incident until T-2 minutes when it was noted that the first stage roll rate gyro spin motor monitor was exhibiting an erratic starting trace on the blockhouse recorder. An effort to demonstrate that the difficulty was with the instrumentation was unsuccessful with the result that insufficient time to correct the difficulty required scrubbing the attempt.

### 2.6 F-O Day Operations (8 February 62)

The F-O day launch countdown began at 0103.0 EST, T-300 minutes on 8 February 1962. Countdown proceeded normally to 0530 EST where a one hour built-in hold was entered. Terminal count was begun at 0620.0EST, T-35 minutes and proceeded to T-12 minutes where a hold was called because of lack of hydraulic pressure in the first stage. The count was recycled to T-15 minutes and a crew went to the pad. It was found that a vernier lox bleed was chilling a hydraulic line in the launch ring. The line was thawed with a stream of water and hydraulic flow achieved. During the rest of the count, the engine was cycled several times to maintain flow thru the line. The count proceeded functionally to T-9 minutes and the count continued to liftoff which occurred at 0743:49.690 EST.

## 3.0 TRAJECTORY

### 3.1 First Stage

The first stage was advanced and right of nominal prior to guidance initiation. The rightward deviation appeared to start at about T+30 seconds and showed up on both real time and predicted impact histories. ETL steering corrections brought the predicted impact history back to nominal. The real time yaw deviation remained to the right of nominal in a parallel fashion. The predicted MECCO impact location was about 80 nautical miles beyond nominal indicating a MECCO velocity in excess of 300 ft/sec above nominal. Flight path angle deviations at MECCO were small in both pitch and yaw. Predicted winds during the high Q region were about 100 knots. The wind direction at this time was primarily West by Southwest. No large shears were predicted for the high Q region; however, a shear of about 16 knots/1000 feet was predicted at an altitude above the high Q region. The effect of these winds would be to displace the trajectory to the right of nominal and to depress the trajectory.

### 3.2 Second Stage

The second stage trajectory remained parallel to the right of nominal. After 14200 seconds the trajectory became lofted with respect to nominal so that by SEC0 the altitude was about 4 nautical miles above nominal. The predicted impact location history was nominal throughout second stage flight indicating a near nominal yaw flight path angle. The SEC0 impact location was slightly up-range of the nominal TPS impact location. Preliminary Range data indicates that SEC0 velocity was about 44 ft/sec above nominal.

### 4.0 SEQUENCE OF EVENTS - All times in seconds from liftoff (Nominal in parentheses)

Lift-off = TPS	12:43:45.9
DAC	12:43:45.81
RANGE	12:43:45
Ignition to liftoff	3.65
Roll Program (2-9)	2.3 - 9.3
Pitch program start (start 10, stop 140)	10.3
First stage guidance (start 90, stop 153)	89.0
Autopilot gain change (110)	210.3
Fuel float switch	247.3
10K float switch	249.5
NECO (159.5)	159.31
Second stage ignition (NECO +4)	163.3
Second stage pitch program (start N + 6)	165.3
HGA ignition (N +10)	169.4
Second stage closed loop guidance (start N +12.4)	175.3
Fairing jettison (N + 24)	284.3
SEC0 (N +132.94)	271.9
Turnoff hydraulics (N + 134.1)	273.5
Coast phase pitch program (start N + 141)	300.3
Turn off ETL (N + 167.6)	325.8
Fire spin rockets (N + 545.5)	704.8
Spin rate (126 + 10% rpm)	323.2 RPM
Third stage separation (N + 561)	706.8
Third Stage burning duration (42 sec)	39.9
Payload separation (N + 1211)	confirmed

### 5.0 PROPULSION

#### 5.1 First Stage

First stage performance was near nominal and the burning time was 199 seconds. An additional 1990 pounds of thrust were provided by the vernier engines.

Propellant utilisation was excellent at a reported 99.99%. It is evident that a portion of the 300 lbs fuel bias was consumed to produce this excellent P. U. due to slightly high fuel tank pressure and slightly low lox tank pressure.

Main engine cut-off occurred as a result of lox exhaustion with switch closure occurring at 8.75 seconds prior to SEC0 and fuel float switch closure normal at 4 seconds prior to lox float switch.

Vernier engine solo operation was disguised by an apparent malfunctioning chamber pressure transducer. Burning time of the vernier however, was normal at approximately 13 seconds.

The following table represents data at 75 seconds.

	Nominal	Accept.	% acc
Main Engine P <sub>c</sub> (psia)	529	536	100
Vernier #1 P <sub>c</sub> (psia)	359	---	353
Turb. In Temp. °F	1225	---	1224
Lox Reg. Ref. P <sub>c</sub> (psia)	---	476	474
Turb. Speed (rps)	6080	---	6075

### 5.2 Second Stage

Second stage performance was near nominal producing an average thrust of 7440 pounds. Cutoff was commanded by ERL after 106.9 seconds of burning time.

TTS operation was obscured during the ignition sequence due to telemetry drop-outs at this time.

Oxidizer out-gassing was evident through approximately 10 seconds after SEC0 and was normal.

HGA ignition occurred at 10 seconds after ignition signal and a pressure of 1389 psig. Sphere pressure was good at lift-off at 1670 psig. At SEC0 PGS was normal at 340 psig and decayed gradually to 290 psig at T+10 minutes.

BHSV-IPS<sub>2</sub> operated normally prior to lift-off at 304/399 psia. However, there is some indication of vibration sensitivity at the IPS-2 threshold valve during normal cycling prior to second stage ignition and again at third stage ignition. Cycling rate gradually increased during captive flight going from 30 seconds just prior to L.O. to 8 seconds at max g and slowing to 49 seconds prior to second stage ignition signal. At T+64 seconds the BHSV came on in this hasty fashion and stayed on for approximately 9.5 seconds.

All parameters were exceptionally smooth in transition and during steady stage operation.

Representative data is presented below at 25, 50, 75 and 100 seconds of second stage burning time.

	Nom.	Accept.	25	50	75	100
Chamber Pr. (psia)	206	206	202	109	201	201
Oxid. Inj. Pr. (psia)	---	261	259	256	256	259
Fuel Inj. Pr. (psia)	---	328	307	305	307	308
Oxid. Tank Pr. (psia)	---	354	333	333	337	337
Fuel Tank Pr. (psia)	---	358	337	332	333	333
Helium Sphere Pr. (psig)	---	---	1400	1210	930	500

The retro system operated well. Pressure prior to lift-off was 4450 psig total and rose to 5375 psig during first stage powered flight due to zero-dynamic heating.

## 6.0 GUIDANCE AND CONTROL

### 6.1 First Stage

The first stage control system performed satisfactorily. The lift-off was smooth with negligible attitude transients. The roll and pitch programs were sequenced on time. All voltages and hydraulic pressure appeared normal. However, at T+40.5 seconds a noticeable transient appeared in all vehicle attitude channels. This transient was quickly damped by the control system, but speculation exists that the cause of this disturbance may be the loss of one or more of the booster aerodynamic fins. Even if this occurred, the loss does not appear to have seriously affected the vehicle's performance during the maximum q region. The maximum pitch and yaw attitude errors near maximum q did not exceed 1.8° and 1.1° respectively. SECO and stage I/II separation sequence were carried out without incident. No significant attitude disturbances developed. Some unusual transients were noted on the hydraulic return pressure telemetry channel. Whether or not these bear any relationship to the pre-launch hydraulic system trouble, described in detail in another section of this report, is not known at this time but analysis is continuing. Regardless, hydraulic system operation was adequate.

### 6.2 Second Stage Powered Flight

The second stage powered flight control system performed satisfactorily. The Stage I/II separation was reasonably quiet with attitude errors in both pitch and yaw not exceeding 1/2°. The usual roll moment existed during stage II powered flight, although somewhat larger than normal, and caused the vehicle to roll in one side of the roll jet dead zone during this period. Fairing was jettisoned as scheduled resulting in only negligible attitude disturbances. Hydraulic pressure, inverter voltages, and bus voltages appeared normal. The pitch program was initiated and terminated as programmed. BPL steering orders were small and their open loop steering was received and responded to approximately 7 seconds prior to SECO. BPL SECO was sent and received in normal manner. Negligible attitude disturbance occurred at SECO indicating a smooth engine shut down. The hydraulic system was shut down as planned approximately 1.6 seconds after SECO and a normal pressure decay resulted.

### 6.3 Coast Flight

Stage II coast flight control was satisfactory. At no time did any of the attitude errors exceed their present deadzone of  $\pm 0.3^\circ$  in pitch and yaw and  $\pm 1.1^\circ$  in roll. This includes the period encompassing stage III spin-up, separation,

stage II retro, and extending through loss of telemetry approximately 85 seconds after stage III spin-up. Stage III spin-up and separation occurred as programmed and caused only minor vehicle attitude disturbances. At stage III separation the spin rate was near nominal and the vehicle was pointed within its  $\pm 0.3^\circ$  roll zone with pitch and yaw rates less than  $0.2^\circ/\text{sec}$ .

## 7.0 GUIDANCE

The MEL vehicle-borne and ground equipment performed well. Steering orders transmitted were small and were executed properly.

## 8.0 SPACECRAFT

Prior to picking up the count on February 5 it was discovered that several of the range mobile units voice transmissions were near Tiros D command frequency. A spare command receiver was placed on the gantry to detect these signals during the countdown. These signals did not command the spacecraft at anytime.

Countdown commenced at 10:03 with the fairing off. All checks performed at this time were satisfactory. After fairing installation spacecraft checks were resumed at 02:30 EST on February 6. At this time it was observed that the IR playback speed on the tape recorder varied and was generally slower. The fairing was then removed and the IR playback recorder checked for operating speed. The recorder checked out normal. The fairing was then reinstalled and the IR playback speed again checked. Again the IR playback speed varied and was generally slower. It was decided that RF emissions with the fairing on was influencing the tape recorder speed regulation circuitry and the spacecraft was reported to be in a GO condition.

During terminal count the pressure regulation in the first stage malfunctioned. Due to the length of time required to adjust this regulator the launch window was used up before completion of terminal count. The operation was rescheduled for February 7 at 07:03 EST.

Countdown began at 23:33 EST on February 6. Spacecraft checks commenced at 02:30 EST on February 7, with the fairing installed. (Fairing had not been removed from previous day's operation). Checkout of the spacecraft was normal and no problems occurred. During terminal count, blockhouse instrumentation indicated a malfunction in the rate gyro, thereby causing a reschedule of the operation to February 8.

On February 7 at 16:00 EST a modified countdown spacecraft check was performed with the fairing installed. The test was satisfactory.

The countdown was picked up at 01:03 EST on February 8. The normal fairing on spacecraft task commenced at 02:30 EST, checkout of the spacecraft was normal and no problems occurred.

Following injection all events occurred at the proper time and all systems functioned properly.

Winkfield, Bagland reported signal acquisition at 1258Z, spacecraft/third stage separation at 1306.56Z and spacecraft despin at 1310.45Z. Vocomex acquired the spacecraft at 1344Z as planned. Reports from Winkfield and Vocomex indicated

the spin rate was between 8.5 and 9.0 rpm. The Tires station at PNR acquired the spacecraft at 1429:21Z and commanded operations of camera system No. 1. Good picture quality and exception of IR playbacks was reported. A readout was obtained as the spacecraft passed over the Wallops Island and RCA, Princeton, N. J. Stations. satisfactory performance from the spacecraft systems operating at that time was noted. Exercise of all spacecraft systems will not be completed until after the fourth orbit.

Orbital element prediction furnished by ANL using F7B-16 radar data during the 2nd stage powered flight and assuming a nominal comet and third stage were:

APOGEE 478, n. mi.  
PERIGEE 399.68 n. mi.  
INCLINATION 48.03°

NEL gave an estimate of:

APOGEE 493 n. mi.  
PERIGEE 394 n. mi.  
INCLINATION 48°

The preliminary orbit data from Spacelab based on early tracking data given:

APOGEE 522 statute miles  
PERIGEE 447 statute miles  
INCLINATION 48.0°  
PERIOD 100.4 min.

## 9.0 DATA AND INSTRUMENTATION

### 9.1 Vehicle Telemetry

The stations listed below were operational. The figures indicate approximate signal recovery times based on preliminary estimates.

Cape Telemetry Station 2 ... T-0 to T + 789 sec.

Cape Telemetry Station 3 ... T-0 to T + 787 sec.

Station 3 (GBI) ... T + 0 to T + 789 sec.

NASA, Cape Canaveral ... T-0 to T+770 sec

Wallop's Island, Va. ... Received signal - coverage unknown

New Boston, New Hampshire ... Received signal to beyond 1000 sec.

St. Johns, Newfoundland ... No report as yet

In general the telemetry was excellent. The ionization flame effects were negligible to the point that no data was lost at this time at any stations monitored to date.

Spin-up was reported from the blockhouse, DAC Data Lab, NASA-F7B Station, Tel 2, and Wallop's Island in real or near real time. Some time discrepancies were noted on the Wallop's report, but further analysis of this will have to await

arrival of the Wallops records. All real-time events for the NASA Control Center were reported on time from the NASA-FPB telemetry station at Hangar AE.

Neither first nor second stage telemetry suffered instrumentation losses, and data throughout useable signal was clear and apparently accurate. The Stage II pitch engine actuator which caused so much consternation during several pre-launch tests, and was noisy during terminal count, showed no abnormal operation during flight. There is some indication that the V. E. #1 chamber pressure transducer hung up at NRCO, but the certainty of this must await further analysis. There also were some noisy portions during early 1st stage flight, but not of much significance.

### 9.2 Data in General

The Range instrumentation was excellent. No cameras were lost (42 out of 42 operated). Beacon track was good at the Cape, PAFB, GHI, and Bermuda FPG-16 radars, indicating a properly functioning beacon. The Range skin track radars also had excellent track.

Telemetry KISSZ, both flight line and program, was quite good. Flight line did experience a small ambiguity between T+34 and 38 seconds, but this is insignificant.

Impact prediction, though somewhat noisy, was considered satisfactory. FPG-16 data was utilized.

### 9.3 Satellite Tracking Station

The GSFC-AIR Satellite Tracking Station monitored the beacon during the countdown and reported frequencies to Specos. The 136.23 mc beacon was used as a signal source for Doppler measurements. The recorded Doppler followed the predicted values very closely, indicating near nominal vehicle performance. The signal was tracked until after third stage burnout and data, though somewhat noisy at this time, showed a third stage burning time of 39.9 seconds. The Minitrack system provided azimuth and elevation angles during the launch. A preliminary look at the data indicated a slightly high vehicle position during the coast phase.

## 30.0 PAD DAMAGE

Only normal pad damage incurred.